WHAT IS CLAIMED IS:

1. A projection optical system for projecting an image of an object onto an image plane, comprising:

a first imaging optical system for forming an image of the object;

a second imaging optical system for re-imaging the image upon the image plane;

wherein said first and second imaging optical systems are disposed in an order from the object side and are disposed along a common straight optical axis, wherein said first imaging optical system includes a first mirror for reflecting and collecting abaxial light from the object, wherein one of said first and second imaging optical systems includes a second mirror for reflecting light from said first mirror to the image plane side, and wherein, with said second mirror, the abaxial light is caused to pass an outside of an effective diameter of said first mirror.

2. A projection optical system according to Claim 1, wherein said first imaging optical system has a magnification β which satisfies a relation $|\beta| \geq 1$.

3. A projection optical system according to Claim 1, wherein said first imaging optical system includes at least one lens.

4. A projection optical system according to Claim 3, wherein said lens has a positive refracting power.

5. A projection optical system according to Claim 1, wherein said second imaging optical system includes at least one lens.

6. A projection optical system according to Claim 5, wherein said lens has a positive refracting power.

7. A projection optical system according to Claim 1, further comprising a lens group disposed between said first and second mirrors.

8. A projection optical system according to Claim 7, wherein said lens group has a negative refracting power and wherein said lens group is disposed between said first mirror and a refractive lens of said first imaging optical system, having a positive refracting power.

9. A projection optical system according to Claim 1, further comprising a field optical system disposed between said first and second imaging optical systems, for projecting a pupil of said first imaging

optical system onto said second imaging optical system, wherein said first imaging optical system comprises a first mirror group of positive refracting power, including at least said first mirror, and a second mirror group including said second mirror, wherein light from said first mirror group as reflected by said second mirror group is caused to pass an outside of an effective diameter of said first mirror group.

10. A projection optical system according to Claim 9, wherein said second imaging optical system is constituted by lenses only and it has a positive refracting power.

11. A projection optical system according to Claim 9, wherein said second imaging optical system has a magnification BG2 which satisfies a relation $-0.5 < BG2 < -0.05$.

12. A projection optical system according to Claim 9, wherein said first imaging optical system has a magnification BG1 which satisfies a relation $-40.0 < BG1 < -0.5$.

13. A projection optical system according to Claim 9, wherein said field optical system is all

constituted by lenses.

14. A projection optical system according to Claim 9, wherein said field optical system comprises a first field mirror and a second field mirror group including a second field mirror, wherein abaxial light passed through the outside of the effective diameter of said first mirror group is reflected by said first field mirror and said second field mirror, in this order, and after that, the light passes a region adjacent the optical axis of said first filed mirror and enters said second imaging optical system.

15. A projection optical system according to Claim 14, wherein said first filed mirror comprises a concave mirror and wherein said second field mirror comprises a convex mirror.

16. A projection optical system according to Claim 14, wherein said first filed mirror comprises a concave mirror and wherein said second field mirror comprises a concave mirror.

17. A projection optical system according to Claim 9, wherein relations $P1 < 0$ and $Pf+P2 > 0$ are satisfied where P1, Pf and P2 are Petzval sums of said first imaging optical system, said field optical

system and said second imaging optical system, respectively.

18. A projection optical system according to Claim 9, wherein a relation $0.6 < e/LM1 < 2.5$ is satisfied where LM1 is a paraxial distance between the object and said first mirror, and e is a distance from the object to a pupil conjugate point defined by an optical element positioned at the object side of said first mirror.

19. A projection optical system according to Claim 9, wherein the distance LM1 satisfies a relation $0.5 < OIL/(LM1+2xLM2) < 20$ where LM2 is a paraxial distance between said first and second mirrors, and OIL is a paraxial distance along the optical path, from the object to the image defined by said first imaging optical system.

20. A projection optical system according to Claim 9, wherein the distances LM1 and LM2 satisfy a relation $0.2 < LM2/LM1 < 0.95$.

21. A projection optical system according to Claim 9, wherein the distance LM1 satisfies a relation $0.15 < LM1/L < 0.55$ where L is a distance from an object plane to an image plane in said projection

optical system.

22. A projection optical system according to Claim 9, wherein said first mirror group has a magnification BGM1 which satisfies a relation $-2.0 < 1/BGM1 < 0.4$.

23. A projection optical system according to Claim 9, wherein said first imaging optical system has a lens group of positive refracting power, disposed closest to the object side.

24. A projection optical system according to Claim 9, wherein said first mirror group includes a lens of negative refracting power and said first mirror.

25. A projection optical system according to Claim 9, wherein said second mirror group includes said second mirror and a lens.

26. A projection optical system according to Claim 9, wherein the abaxial light from the object passes a lens of said second mirror group before it is incident on said first mirror group.

27. A projection optical system according to

Claim 9, wherein a positive lens, included by said field optical system, is disposed just after the image plane side of said first mirror group of said first imaging optical system.

28. A projection optical system according to Claim 14, wherein a relation $0.45 < LFM1/LFM2 < 0.8$ is satisfied where LFM1 is a distance between said second field mirror and said first field mirror, and LFM2 is a distance between said second field mirror and the image plane.

29. A projection optical system according to Claim 14, wherein said second field mirror group includes said second field mirror and a lens.

30. A projection optical system according to Claim 14, wherein a positive lens, included by said field optical system, is disposed between said first mirror of said first imaging optical system and said second field mirror of said field optical system, wherein light reflected by said second mirror of said first imaging optical system passes said positive lens and then is reflected by said first field mirror.

31. A projection optical system according to Claim 1, wherein said projection optical system is

telecentric with respect to each of the object side and the image plane side.

32. A projection optical system according to Claim 1, wherein said projection optical system has a magnification of reduction ratio.

33. A projection optical system according to Claim 1, further comprising a field stop disposed at the position of the image defined by said first imaging optical system, for changing at least one of a size and a shape of an imaging region upon the image plane.

34. A projection optical system according to Claim 1, further comprising a stop disposed inside said second imaging optical system.

35. A projection exposure apparatus for projecting a pattern of a mask onto a substrate through a projection optical system as recited in any one of Claims 1 - 34.

36. A projection exposure apparatus according to Claim 35, wherein laser light from one of an ArF excimer laser and an F_2 laser is used for the projection exposure.

37. A device manufacturing method, comprising the steps of:

printing a device pattern on a wafer by exposure, using a projection exposure apparatus as recited in Claim 35 or 36; and

developing the exposed wafer.